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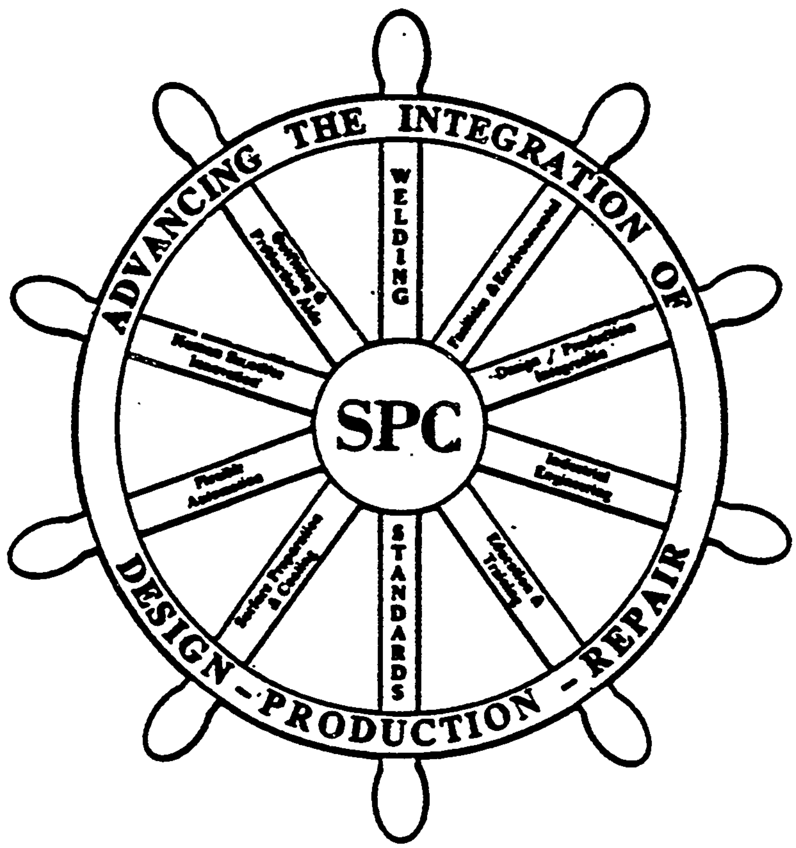

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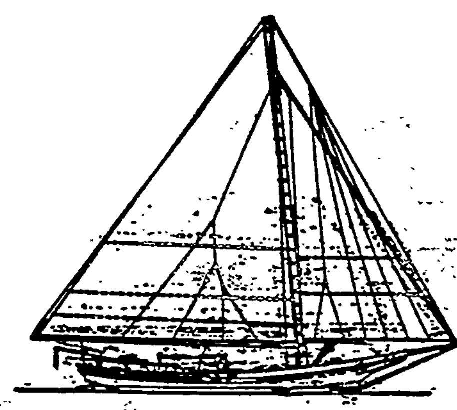

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No. 24

Designing the Future U.S. Naval Surface Fleet for Effectiveness and Producibility

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Abstract: David Taylor Research Center is just commencing investigations into a new manner of defining future fleet architectures. The cost of current performance-driven ship designs has increased at a rapid rate. While it is true that a warship designed with insufficient performance is of meager utility, it is also true that the best performing warship design is of no utility if never built. Both performance and affordability are required if sufficient numbers of ships are to be built to counter the threat. By designing a future fleet architecture with producibility as a major requirement from the start, we hope to impact the acquisition cost significantly. One battle force concept titled "Distribute, Disperse, Disguise and Sustain" suggests two fundamental surface ship types; the Carrier of Large Objects (CLO) and the Scout Fighter. A CLO feasibility design in progress, Carrier Dock Multimission, is outlined to inform shipbuilding researchers of an initiative that promises to have significant impact on naval ship procurement and provide increased visibility within the U.S. Navy on producibility issues.

Before attempting to conceptualize a future United States naval surface fleet, to help create a vision of the U.S. Navy for the year 2030 and beyond, the shortcomings of the current surface Navy must be addressed first. An honest assessment of where we are now is a must for us to determine where we need to be in the future and how to get there.

"CURRENT SHORTCOMINGS

The shortcomings of greatest significance in the current surface Navy that are related to Hull, Mechanical and Electrical technologies are:

- Highly observable ship signatures
- Easily discriminable ship signatures
- Concentration of operating functions
- Logistically demanding
- Programmatically inefficient and expensive to acquire.

The ships of the surface navy are highly observable by radar, acoustic, iofrared, magnetic, and electro-optical sensors. As the enemy's surveillance, tracking, and classification capabilities increase with time, the advantage will continue to shift more and more to the enemy. The result is that the enemy can, in most cases, engage our surface forces outside the battle space of our own weapon systems. This forces us into a defensive posture that requires us to shoot down the "arrows" (cruise missiles) rather than the "archers" (aircraft, submarine and surface ship launch platforms).

Forty-two classes of surface ships currently operate in our carrier battle groups, surface action groups, amphibious task forces, logistic support groups, and convoy escort groups. Each of these ship classes (and, indeed, most of the ships within a particular class) has unique signatures that allow the enemy to discriminate ships within a surface force. This plays to the enemy's strength of massing fire power on whatever type of ship their strategy calls for.

We have generally concentrated required operating functions on large ships. This platform architecture, coupled with the high observability and discriminability results in an inherently vulnerable force structure, requiring extensive investment in long range, layered defense. The enemy can target the ships that carry our tactical aviation assets, our projection of power amphibious assets, our logistic support train, and our defensive area anti-air warfare (AAW), anti-submarine warfare (ASW), and anti-surface warfare (ASUW) assets. The recent move to distribute our cruise missile strike capability among a wide range of surface and submarine assets is a sound move away from the inherent shortcomings of the concentration of functions architecture.

The surface forces are extremely demanding of logistics support. With probable future closings of oversea bases and increasing host country restrictions on use of those bases retained, the demand for long-distance, high-volume, prompt logistic support will be compounded. Fuel represents the most immediate demand of our surface forces while underway. With the exception of our few nuclear surface ships, the surface Navy has ignored fuel efficiency. Our ships are manpower intensive, and human support requirements are logistically demanding. Because

there are so many ship classes with little attention to standardization, underway and overseas maintenance requires extensive logistic support. Finally, and most important in times of war, U.S. Naval surface forces require the transfer of huge volumes of ordnance at sea. With the introduction of larger cruise missiles and extended range AAW and ASW missiles, this transfer has become a serious problem.

Over the last ten years the surface Navy has acquired eleven ships per year of nine different ship classes. These ships were constructed in seven shipyards. The number of different major contracts for government furnished material and contractor (shipbuilder) furnished material is in the tens of thousands. The current platform architecture of many classes of specialized ships with minimum standardization is programmatically demanding. The demand on the Navy's technical and programmatic infrastructure now exceeds the Navy's billet allowances. The United States' shipbuilding industry, along with the supporting marine industry, has become weakened and vulnerable now that the U.S. Navy is the only major customer.

A possible root cause of these five problems is the lack of a master architecture and supporting technical and programmatic strategy for the surface Navy. A coherent vision and a road map for the future needs to be formulated.

MISSION REQUIREMENTS FOR THE FUTURE SURFACE NAVY

Considering the above current shortcomings, is there a viable role for the surface Navy in the future? We believe there is because the inherent strengths of the surface Navy include:

Real-time force direction and control enabled by command, control and communications (C^3) continuity,
Efficient bulk lift capacity
Flexible and visible overseas presence
Relatively low acquisition cost for a presence at the interface between undersea and air
Unique ability to project and protect power ashore when that power includes combined land and tactical air combat forces of any significant size

It is certainly appropriate for the Navy to investigate entirely new force architectures consisting of different schemes for distributing required operating functions on alternative platform types. In the future there may be some shift towards a greater dependence on submerged ships; land-based aircraft with greatly extended endurance, and other concepts not even conceived at this time. Our current vision of the future indicates there will be a substantial surface Navy because of the inherent strengths of this type of warfare platform.

The projected roles and future missions of the surface ships must be conceptualized in coorainaticl with the projected mission requirements of other elements of the navy, notably the submarine force. There are other elements of the surface navy not addressed in this paper, such as mine warfare, combat/forward area repair and special operations. "Surface Navy" in this paper refers to the battle force structured elements.

A PROPOSED PLATFORM ARCHITECTURE FOR A FUTURE SURFACE NAVY

A platform architecture describes how the required operating functions assigned to the surface navy are distributed among the many types of platforms and how these required operating functions are integrated. One must also address the C^3 architecture of the surface Navy to realize the complete perspective. This section addresses the platform aspects of a postulated architecture.

The current architecture of the surface Navy is much as it has been during and since World War IL There are discrete force compositions:

- Carrier Battle Group
- Surface Action Group (Battleship Battle Groups)
- Amphibious Task Forces
- Underway Replenishment Groups
- Convoy Escort Groups (Protection of Shipping)

Within each of these forces, the capital ships transport and support the principal commodity

Aircraft Carrier – tactical aviation aircraft
Battleship – large caliber guns and cruise missiles
Amphibious Transports – Marine amphibious forces
Logistics Transports – logistic (direct support) material
Merchant Ships – resupply material

Within each of the forces, the defensive AAW and ASW combat systems are located in the escoits – cruisers, destroyers, frigates. The C^3 functions are distributed between the capital ships and the escorts. With the introduction of Tomahawk cruise missiles, Strike and ASUW capability is contained in the larger surface combatants as well as the air wing of the the aircraft carrier.

In an earlier section of this paper, the inhe shortcomings of the surface Navy were discussed. Whatever future architecture the United States Navy adopts for its surface Navy, this architecture should be designed to minimize these shortcomings. The brute force approach which results when problems are masked (rather than the source of problems removed or at a minimum mitigated) could eventually be unaffordable. Continuing the current architecture, which is inherentiy vulnerable and days to the strength of our principle adversay,"the Soviet Navy,

will require a never-ending expansion of our battle space and continued, ever-increasing investment in expensive combat systems to provide the required defense in depth.

In order to overcome existing shortcomings and exploit new technology implications in G, space and weapon systems, the Navy should explore new architectures for its surface forces. The David Taylor Research Center has been studying an architectural option which is designed to reduce each of the five fundamental shortcomings previously discussed. This architecture has been a product of the Round Table strategic planning process developed at DTRC as well as extensive participation in recent war games held at the Naval War College in July 1988.

The architecture option is called "D^3 + S" from the key attributes achieved, namely:

- Distribute
- Disperse
- Disguise &
- Sustain

Distribute. The architecture emphasizes distributing the surface Navy's required operating functions into a wider range of platforms. In addition, the concept would discourage concentrating critical functions on single purpose ships. A capital ship would carry two or perhaps three functions. The primary motivation for this greater distribution of functions is to make it more difficult for an enemy to target and then mass its firepower on a single high value unit. The loss of a capital ship would result in the loss of one third of three critical functions rather than all of one function.

Disperse. The surface assets would also be dispersed over a greater area of the ocean. This dispersion would further work against the Soviet's strength of massing firepower.

Disguise. The ships of the surface Navy would be designed with observability as low as possible consistent with a functioning, affordable surface ship. Thus the ships would strive for maximum disguise relative to the "noise' of the ocean. Additionally and equally important, the surface ships signatures would be designed to be as undiscriminable as possible. The motivation is to make it near impossible for the enemy to classify targets and determine which ship carries a particular required operating function.

The desired result of D^3 (Distribute, Disperse, Disguise), is to cause the enemy to come well within US. Navy battle space to detect, classify, target, and engage U.S. surface ships. This will make our existing combat systems far more lethal in defense of the surface forces. The advantage shifts to our side as we now will be shooting down the "archer" before the launch of the "arrows".

The fundamental thrust of this architecture is the removal or mitigation of inherent vulnerabilities of surface forces caused by high observability, discriminability, and concentration of functions. The expectation is that the current trend of requiring longer range, reduced reaction time combat systems will be reversed. Intuitively, we expect this to be a less expensive and more cost-effective approach. To verify the validity of this statement will require extensive systems engineering and systems analysis studies.

Sustain. The word "sustain" in the context of the D^3 + S architecture refers to the requirement to substantially increase the sustainability of each of the ships of the D^3 + S force. The submarine navy has emphasized the close relation between stealth and sustainability since the introduction and total commitment to nuclear submarines. it is nonsensible for a low observable ship to require frequent resupply from a highly observable logistic support ship.

A typical surface combatant ship must leave station in a earner task force every three days in order to maintain a fuel load above the desired sixty percent. Conventional aircraft earners require approximately the same periodicity of aircraft fuel replenishment during sustained flight operations, CVN'S somewhat less frequent. In time of combat the demand for the replenishment of ordnance is expected to occur even more often. Resupply to satisfy the human support requirements can be extended beyond thirty days during normal operations. Providing for underway maintenance requirements is more difficult to predict.

The requirement for frequent replenishment at sea adds substantially to the inherent vulnerabilities of an underway surface force. The signatures of the ships increase during the high speed transit to and from station. The logistics ships themselves may very well be the Achilles' heel of the force. The ships shuttling fuel, ordnance, and stores from ports to the AOES and AOR'S are particularly vulnerable.

The D^3 + S concept as an architectural option, summarized in Figs. 1 through 6, has the potential to reduce the inherent vuinerabilities of the current surface battle forces. With this hope, goals and system concepts consistent with this architecture have been developed.

Appendix A provides a category listing of the preliminary quantitative, time-phase goals that have developed through the H, M&E strategic planning process.

The setting of these goals is a mandatory first step in conceptualizing system concepts and prioritizing technology clusters.

SYSTEM CONCEPT FOR THE D^3 + S ARCHITECTURE

The David Taylor Research Center has formed systems engineering teams to conceptualize system concepts building on the D^3 + S architecture and goals. The most promising system concept is described.

The system concept that has the potential for meeting the requirements of the D^3 + S architecture and the ensuing goals consists of a concept where the surface navy necks down to two parent types of ships, namely a Carrier of Large Objects (CLO) and a Scout Fighter (SF). Both ships would be designed with significantly reduced signatures compared to current surface practice. Furthermore, the signatures of the CLO and SF would be as indiscriminatable as possible. Both ships would incorporate design features to extend their on station time considerably in excess of today's capabilities.

Carrier of Large Objects (CLO). The surface Navy carries the following large objects:

- Aircraft and their operating and support equipment and personnel
- Marines and their amphibious equipment
- Logistic material and transfer equipment
- Mobile repair equipment (i.e., tenders)
- In the future, autonomous vehicles (underwater, surface, and air).

A list of current CLOs and their cargo is contained in Table L

The system concept calls for one low-obser able, highly sustainable ship class that is capable (transporting and supporting each of these categori of large objects. The variants would differ in arran ment as required by the demands of the large objects, but they would appear similar from a signatu standpoint and utilize similar subsystems to the maximum extent possible.

In order to make this system concept remote reasonable, the large objects (future aircraft, amphi ous equipment, logistic transfer equipment, repair equipment, and autonomous vehicles) will need to conceptualized in parallel with the CLO. Clearly thi is a concept which will require thirty to forty years t implement fleet wide.

A CLO concept which is currently designate at DTRC as Carrier Dock Multi-mission (CDM) envi sions multiproduct variants, one variant for each major mission area, i.e. amphibious, direct logistics support, repair, carrier of aircraft or carrier of auton mous vehicles (manned or unmanned). The comm framework consists of a conventional monohull with welldeck and flightdeck, with integrated electric dri and intercooled, regenerative gas turbine engines.

Ship concept studies are underway to size ε configure a notional CDM along with its possible cc ceptual variants, shown in Figs. 7,8 and 9. The star ing point will concentrate or, Carrier Dock Amphibi (CDA) and Carrier Dock Logistic (CDL) variants. Notional CDA and CDL requirements are shown in

Table I. Current U.S. carriers of large objects summary

TYPE	NO.	LENGTH	DISPL (k LT)	SHP (kHP)	SPEED (kts)	CARGO
CVN	5+2	1092	91	260	30+	90 + AIRCRAFT
CV	10	1046	81	280	30+	85 AIRCRAFT
BB	4	887	58	212	35	GUNS & MISSILES
CGN	9	585	10	100	30+	MISSILES
LCC	2	620	18	22	23	COMMAND AND COMMUNICATIONS
LHD	[1+10]	844	41	70	20+	3 LCAC, 42 HELO, 1900 TROOPS
LHA	5	820	39	70	20+	1 LCAC, 38 HELO, 1700 TROOPS
LPH	7	602	18	22	23	27 HELO, 1750 TROOPS
LPD	13	570	17	24	21	6 HELO, 900 TROOPS
LSD	9+10	609	16	42	20+	4 LCAC, 4 HELO, 338 TROOPS
LST	18	522	8	16	20	LVT's, TANKS, 420 TROOPS
LKA	5	575	19	19	20	HEAVY LIFT, 226 TROOPS
AE	13	564	18	22	20	ORDNANCE
AFS	7	581	18	22	20	2600 T DRY STORES, 1300 T REEFER STORES
AO	5	592	26	24	20	120,000 BARRELS OF FUEL
AO m	2	644	34	13.5	18	184,000 BARRELS, 200 T AMMO, 100 T REEFER
AO	20+	679	40	32	20	180,000 BARRELS OF FUEL
AOE	4+4	793	53	100	26	177,000 BARRELS, 2100 AMMO, 500 DRY, 200 REF
AOR	7	659	38	32	20	175,000 BARRELS, 600 AMMO, 400 DRY, 100 REF

Source: Jane's Fighting Ships; not official U.S. Navy figures

Table Il. A ship of between 30,000 and 40,000 tons full load has been used as a starting point and an early conceptual drawing in included as Fig. 10. Other features of the CDM concept are summarized in Fig. 11.

Scout Fighter (SF). The scout fighter would share the functions of command and control, surveillance, offensive, and defensive combat capability. The scout fighter is envisioned to be a far smaller, more mobile and less expensive ship than the Carrier of Large Objects.

The distribution of functions between the CLO and SF has many possibilities. On one extreme the SF could be a relatively independent, fully capable, multi-warfare capable ship much like the cruisers of today. On the other extreme the SF could be an unmanned autonomous vehicle supported by the mother ship. There is a wide range of differences in SF capabilities between these two extremes. Current scout fighters (cruisers, destroyers, frigates) are summarized in Table Ill.

Even though the SF would be a smaller, more mobile ship as compared to the CLO, the SF would be designed with similar low signatures. This would be accomplished by incorporating the same subsystem and component concepts that are the source of the emissions which result in ship signatures. As an example, both ships would use the same type of propulsor and prime mover. The two ships could be designed with the same basic topside configuration and materials. Active signature control techniques would also be required.

This battle force system concept based around only two parent ship classes with a large degree of ship design commonality has the potential for significant programmatic cost savings in areas of both acquisition and operating and support costs. Longer production runs will permit the shipbuilding industry to more aggressively adopt modem shipbuilding techniques, such as more extensive use of process flow lanes, preoutfitting, and modularity. Capital investments would become more attractive to shipbuilders, and various producibility concepts become more economic. Commonality would greatly lessen fleet introduction, training infrastructure and other logistic support costs.

Table II. Notional CDA and CDL design requirements

Feature	CDA	CDL
Signature	low observable	same low observable
Cargo fuel	185,000 gals	120,000 barrels
Cargo ammo		150,000 Cu ft
Cargo dry stores		830 tons
Cargo reefer stores		350 tons
Containers (B′ x 8′ x 20′)	2 (minimum)	150
Troops	950 men	
Square footage	21,000 Sq ft	
Cubic footage	37.000 cu ft	
LCAC′s/barges	2	
Boats (LCM 6 equivalent)	9	2
Aviation Facilities		
heloslplanes	10 helos/planes	4 helo
hanger & repair	yes	yes
UNREP suite		
CONREP	3 fuel, 1 cargo	5 fuel, 1 cargo
VERTREP	3	3
Sustained speed	20 knots	20 knots
Endurance (min)	10,000 nm @ 20 kts	10,000 nm @ 20 kts
ship stability	< common >	
Habitability standard	< common: Navy standard >	
Manning	c as per goals >	
Combat System	< corn-mom TBD >	
Margins	< common >	
Survivability	< common low signature, SRBOC, collective protection, doublelsteel hull >	
Propulsion Machinery	< common: integrated electric gas turbine/lCR >	

This two ship concept could have major ramifications on the shipbuilding and marine industrial base. Careful planning would be required to architect the "Distributed industrial base consistent with the D^3 + S platform architecture. There will be far less variety of materials, components, and standards in this system concept. This could result in a considerable neck down in the number and diversity of marine

Table III. Current scout fighters.

TYPE	NO.	LENGTH	DISPL (k LT)	SHP (kHP)	SPEED (Ids)	PAYLOAD
BB	4	667	58	212	35	Large guns. miseilles, flag facilities
CGN	9	585	10	100	30+	Missiles, guns
CG	32	567	9.6	80	30+	Missiles, AEGIS on half of them
DDG	37	437	4.8	70	30	Missiles, guns
DD	31	563	7.6	80	33	Guns, ASW helos
FFG	46	445	3.6	40	29	Missiles, ASW helos
FF	49	438	3.9	35	27	farge sonar. ASW helo

Source: Jane's Fiahtina ShiDa not official U.S. Navy figures

suppliers. It is likely that the Navy shipbuilding and repair business will be concentrated in a smaller number of shipyards. A specific shipbuilder or supplier may specialize in a particular process flow lane to provide preoutfitted subsystems, which are then shipped to assembly yards.

The two ship system concept could greatly alleviate the current severe problem of a size-constrained government technical and program support infrastructure being unable to provide the ship design and fleet technical support for the highly diverse surface force of today. Afar more streamlined and disciplined support organization would result from this neck down of ship classes.

The size of these two concepts relative to today's missions and ship types are shown in Fig. 7. The specifics of the size variation of the SF will greatly depend on the distribution of functions between the CLO and the SF, affordability constraints, and projected weapon system characteristics.

TECHNOLOGY CLUSTERS

The concept of clustering technologies that have synergistic and programmatic linkages has merit for any platform architecture. It has particular merit when coupled with the D^3 + S architecture and the resulting two ship system concept.

Technology clusters have been identified at the David Taylor Research Center which serve as building blocks for ship concepts which meet the specified goals. As of the writing of this chapter, five technology clusters have been identified and are in the process of system definition. These five clusters are:

- Cluster A – Advanced Machinery Systems
- Cluster B – Advanced Hull Technologies
- Cluster C – Advanced Topside Technologies
- Cluster D – Manning and Human Support
- Cluster E – Propulsion Powered Combat Systems

These five technology clusters vary significantly in maturity and definition and the systems analysis completeness explaining the cost benefit of each of these clusters in the context of the D^3 + S architecture, the goals, and the CLO/SF system concept also varies.

TRANSITION PLAN TOWARDS THE D^3 + S ARCHITECTURE

The Navy will have rebuilt itself by the year 2030. By that date the ships and systems of the current Navy will have been retired or very nearly so. In this context ships and systems actually in the fleet plus those under construction are considered to be part of today's Navy. One must reach out beyond this forty year time frame to be able to conceptualize a Navy unencumbered by current force architecture, current systems, and current government and industrial infrastructure.

The transition Navy is the forty year period of time between today and the future (2030+), see Fig. 12. The first twenty years can be considered as near term and the next twenty years as mid term. The Navy must have a vision of the future architecture, system concepts, and support infrastructure to be able to lay out a road map towards that vision. Far too many technology investment decisions are influenced by today's constrained perspective. This leads to a replacement in kind system solution, an evolutionary upgrade that may not address the fundamental source of shortcomings. It encourages the maintaining of paradigms no longer valid.

Both the neck down in the number of ship classes as well as the change in the design philosophy and acquisition strategies of ail near term ship building programs should begin as soon as possible. One concept of future surface battle force composition (approximately one-half of the entire Navy) is shown in Fig. 13. A postulated timeline for CDM and SF technology and procurement is shown in Fig. 14. A conjectured 2030 CDM/SF fleet makeup is described in Fig.15.

EFFECTIVENESS AND COST ASSESSMENT

A key element of the Strategic Planning procedure is to evaluate the military worth of projected future ship concepts and assess the cost to implement them. for an overall evaluation of cost effective-

ness. At DTRC, this is done by an independent assessment group. Much work remains to validate existing assessment models, increase their flexibility to assess more far-reaching technology concepts, and to develop assessment models in additional mission areas.

PRODUCIBILITY

Producibility is not presently considered a major element in the naval ship design process for several reasons.

- There exist a myriad of other elements that are considered more critical.

- There has been a decided lack of visibility and external pressure to increase the producibility of the ship design. Producibility is not as patently obvious as a hydrostatic problem which results in severe list, or a naval gun that cannot fire. Lack of producibility in design is more insidious but no less important.

- There is a preception that the design community does address producibility through weight minimization or cost constraints. While these are related to producibility, they can easily create a design decision that is out of equilibrium. (Note 1)

- A lack of awareness of the relative leverage of various ship subelements and design phases for improving producibility and thus increasing the ship's overall cost-effectiveness.

- A lack of detailed data on specific producibility concepts.

- A lack of any riaorous methodology for the assessment of producibility.

In the thesis "Producibility as a Design Factor in Naval Combatants" [reference 2] producibility was categorized into wartime (time oriented) and peacetime (cost oriented). Peacetime producibility was further divided for consideration into Fleet Concept, Preliminary Ship Layout, Production Details, Shipyard as Factory, and Economic Considerations. The thesis proposed a peacetime producibility evaluation methodology. The Distribute, Disperse, Disguise and Sustain (D^3+ S) architecture outlined above and the Carrier Dock Multimission ship design feasibility studies getting underway are an attempt to consider producibility at the very inception of ship design, in the Fleet Concept arena.

SUMMARY

The structure of H, M&E technologies presented in this chapter is an outgrowth of an evolving strategic planning process at DTRC. It consists of (a) the definition of quantitative time-phase goals necessary to overcome the perceived shortcomings; (b) the identification of clusters of synergistic technologies that provide maximum leverage in satisfying these goals; (c) system concepts that incorporate and exploit these technologies; and d) an overall architecture in which they can be evaluated. A specific force architecture (D^3+ S) has been proffered to evoke discussion and further evaluation.

This discussion of R & D planning is presented in this forum because producibility has too often been an afterthought to the ship design and force architecture procedure. Only by committing some small percentage of the navy's assets to long range strategic R & D planning, and integrating the planning of inter-related portions of the navy, can the challenges '- of the future threat be met within increasing fiscal, manpower and industrial base constraints. The vision of the future U.S. naval surface fleet presented above is not the only possible vision, nor is it the complete vision. For instance, an examination is warranted of what synergisms this battle force vision might have with a merchant ship of the future.

The scope of the challenge can be overwhelming, but a start has been made. Between vision and reality lie years of dedicated engineering. This engineering must be tied together on the systems plane, with the producibility aspect given a strong voice in the earliest stages.

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Note 1: The equivalence of ship weight to ship acquisition cost is a common falicy. While it has merit in some applications, it is used for conceptual designs with technical innovations that extend the costing method far past its range of reasonableness. An extreme example of the "weight as cost" concept running afoul is the Patrol Hydrofoil Missile (PHM). The PHM-1 leadship used small, lightweight structural sections, close stiffener spacing and thin gage welded aluminum materials to save weight in the weight-critical high performance ship. While the result was low weight, excessive costs resulted from problems such as weId distortion, part fitup and poor welding accessibility. An extensive structural redesign for the follow ships resulted in a mere 5% increase in weight for a 689% reduction in typical midship bulkhead cost. [reference 1]

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APPENDIX A

Initial categories of Hull, Mechanical and Electrical Goals set and prioritized in the Strategic Planning Process. These are to be interwoven with Combat System goals to give the Navy timephased and quantitative goals over the spectrum of ship design. These attributes were originally set for a surface combatant (Scout Fighter); ongoing work wil modify attributes, add attributes and revise priorities as required for the Carrier of Large Objects and deployable vehicles.

1. Radar Signature
2. Acoustic Signature
3. Survivability (Vulnerability)
4. Damage Control
5. Chemical, Biological and Radiological Defen
6. Fire Protection
7. Range and Endurance
8. Acquisition Cost
9. Infrared Signature
10. Reliability, Maintainability, Availability
11. Operating and Supporl Costs
12. Seakeeping
13. Wake Signature
14. Speed
15. Extreme Cold Weather Operations
16. Logistics
17. Maneuverability
18. Magnetic Signature
19. Electro-Optic and Visual Signature

D istribute

D isperse

D isguise

+

S tay

Two Fundamental Ship Types...

Carrier of Large Objects (CLO)

Scout Fighter (SF)

Design ships and battle force architecture for long sustainability

Fig. 1 – D^3 + S architecture applies to ships

D istribute

D isperse

D isguise

+

S tay

Large Objects

Aircraft attack, air superiority, EW, ASW, logistics, heavy lift, assault, scout

Logistics ship fuel, aircraft fuel, dry stores, reefer stores, ordnance, vehicles, repair parts

Amphibious assault aircraft, assault vehicles, troops, mechanized equipment, ordnance, fuel, supplies

Large Combat Systems large missile magazines, future systems, heavy caliber guns, directed energy weapons

Autonomous Vehicles fighters, scouts, decoys, special operations, replenishment

Other command & control, repair

Fig. 2 – D^3 + S architecture applies to large objects

D istribute

D isperse

D isguise

+

S tay

<u>Scouting / Fighting Duties</u>

Command & Control	
Surveillance	air, subsurface, surface
Offense	land, subsurface, surface
Defense	air, subsurface, surface

Fig. 3 – D³ + S architecture applies to SF duties

Aimed at Removing the Source of Force Problems:

- **Observability of Ships**
- **Signature Discriminatability** 〉 Allows Enemy to mass firepower beyond our own defenses
- **Concentration of Functions** – Loss of one ship means loss of commodity
- **Logistically Demanding** – Long, demanding logistics tail is expensive and vulnerable
- **Programatically Demanding** – expensive and time consuming

Objective: Reduce inherent vulnerability by:

<u>D</u>istributing, <u>D</u>ispersing, <u>D</u>isguising assets and reducing extent and vulnerability of logistics support by . . .
<u>S</u>ustain (design for staying power)

Fig. 4 – D³ + S architecture helps remove problems

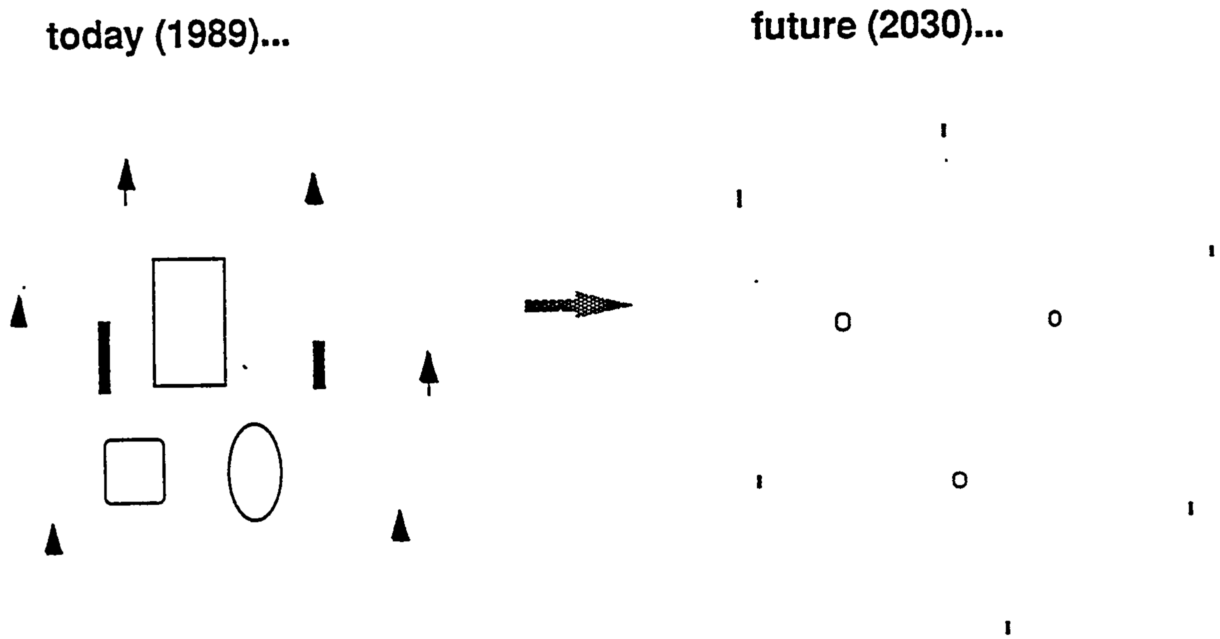


Fig. 5 – Proposed force level group change

- **Increased Military Effectiveness**
  - Shrinks Red's battlespace well within Blue's battlespace
  - Negates Red's massing firepower on Blue's high value units
  - Enhances effectiveness of Blue's decoys
- **Reduced Cost**
  - Reduced cost through standardization allows either more units or higher quality units

resulting in . . .

Fig. 6 – Key reasons for proposed change in architecture

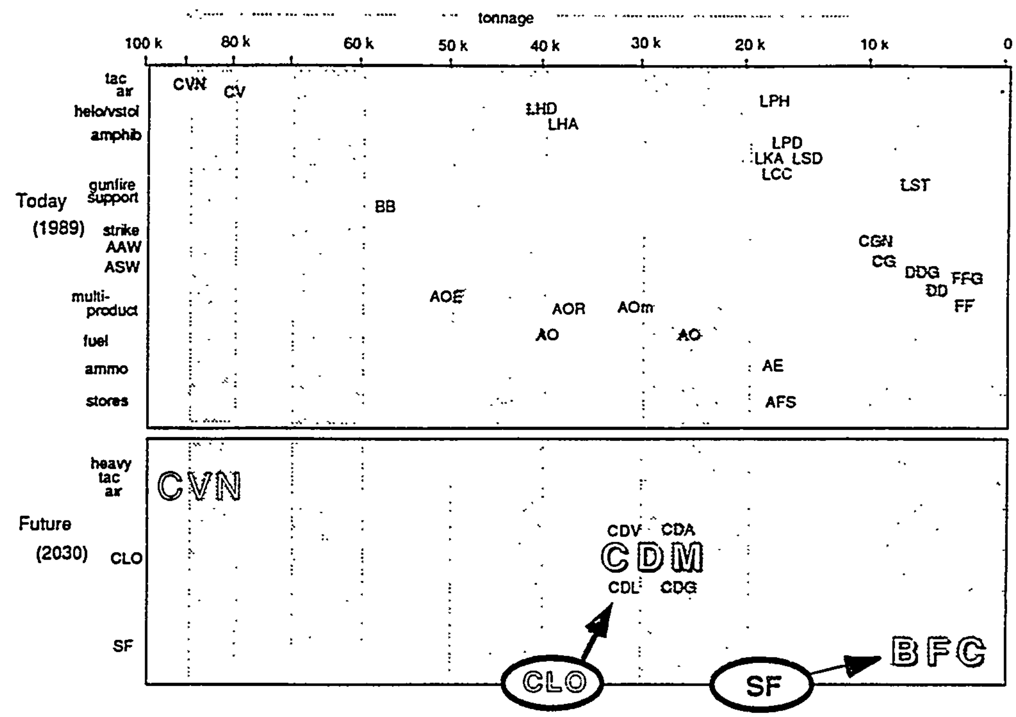


Fig. 7 – Mission and tonnage perspective

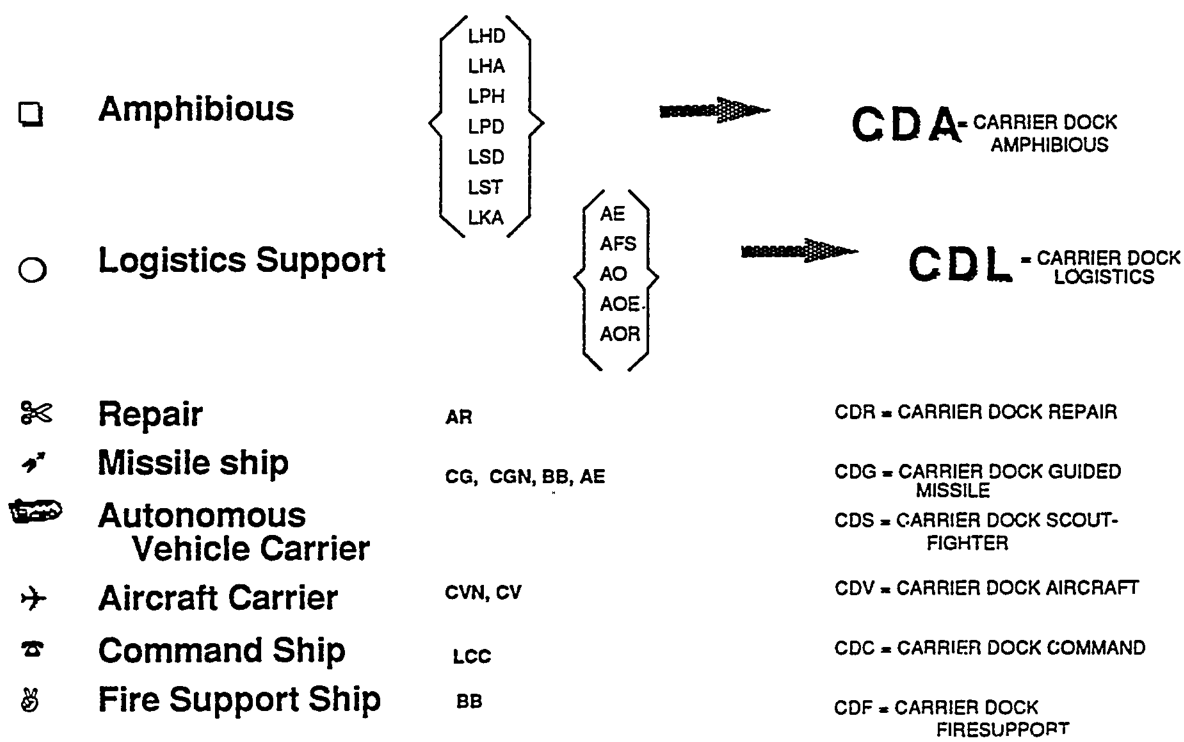


Fig. 8 – Carrier dock multimission variants

disguise which ship is which within a taskgroup/taskforce

disguise which taskgroup is which

balance the ships within a group so that the loss of one vessel (by enemy, equipment failure or tasking) does not jeopardize the mission

reduce ship design costs by commonality

reduce program costs by minimizing the number of programs and reducing overhead

reduce ship production costs by maximizing repeats

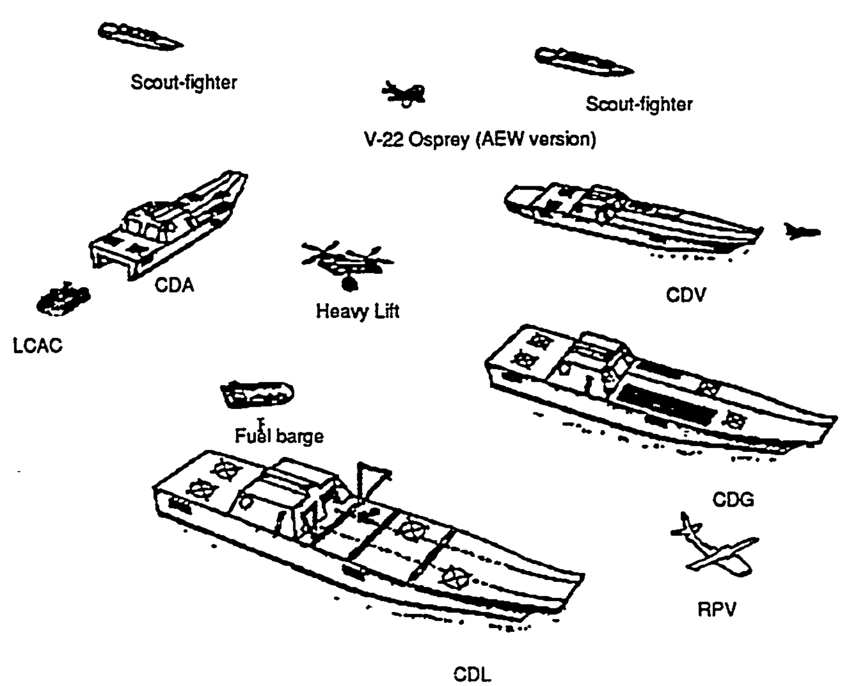
expand U.S. shipbuilding base thru repeats allowing shipyards to make significant capital improvements

provide for improved ship availability through common subsystems

reduce logistics supportthrough common subsystems and simplified logistics support shuttle

graceful, gradual transition from current fleet architecture to future fleet architecture as replacement ships phase in; flexibility to meet changing needs over the years

Fig, 9.- Why CDM?



This is not a typical grouping, as various task organizations would be made to support a particular mission. For instance, an amphibious mission might have ...

- 6 CDA
- 1 CDG
- 1 CDV
- 6 Scout-fighters

The conceptual CDV has a possible pusher-tug for additional speed, use as a fuel barge or to propel a mobility-damaged CDM within the task group.

CDA = amphibious variant
CDL = logistics variant
CDV= air capable variant
CDG = large guided missile variant

Fig. 10 – Carrier dock multimission (CDM) variants [conceptual]

reduced signature

- reduced discernibility
  reduced discernibnility
- de-emphasize ship speed but maximize
  weapon and scouting speed
- emphasize endurance and independence from external support
  during mission
- well deck on all CLO's within taskforce opens alternate
  replenishment schemes
- additional vertrep pads on all variants
  expands operational use of VERTREP vice CONREP
- similarities of the variants permit multimission usage, ie
  logistics variant for amphibious surge or amphibious variant in
  logistics role

Fig. 11- Other features of CDM

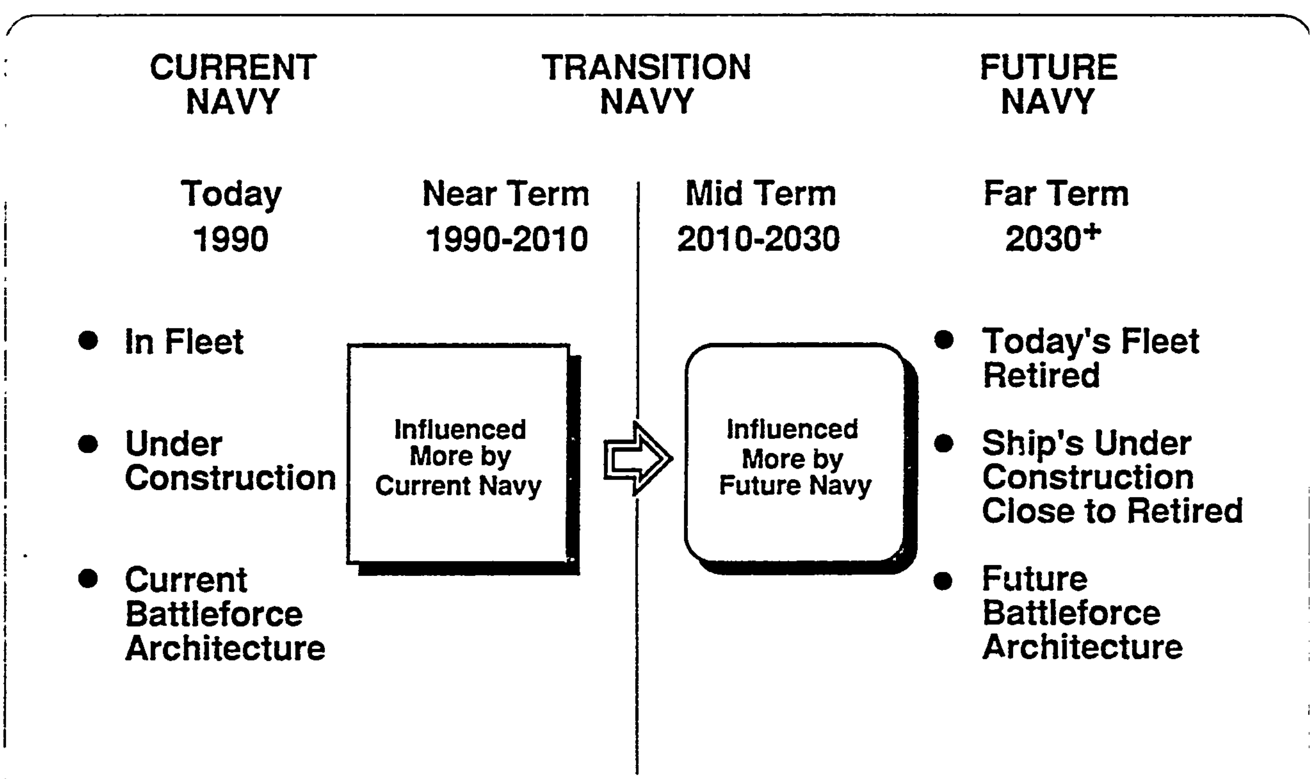


Fig. 12 – Planning timeframe

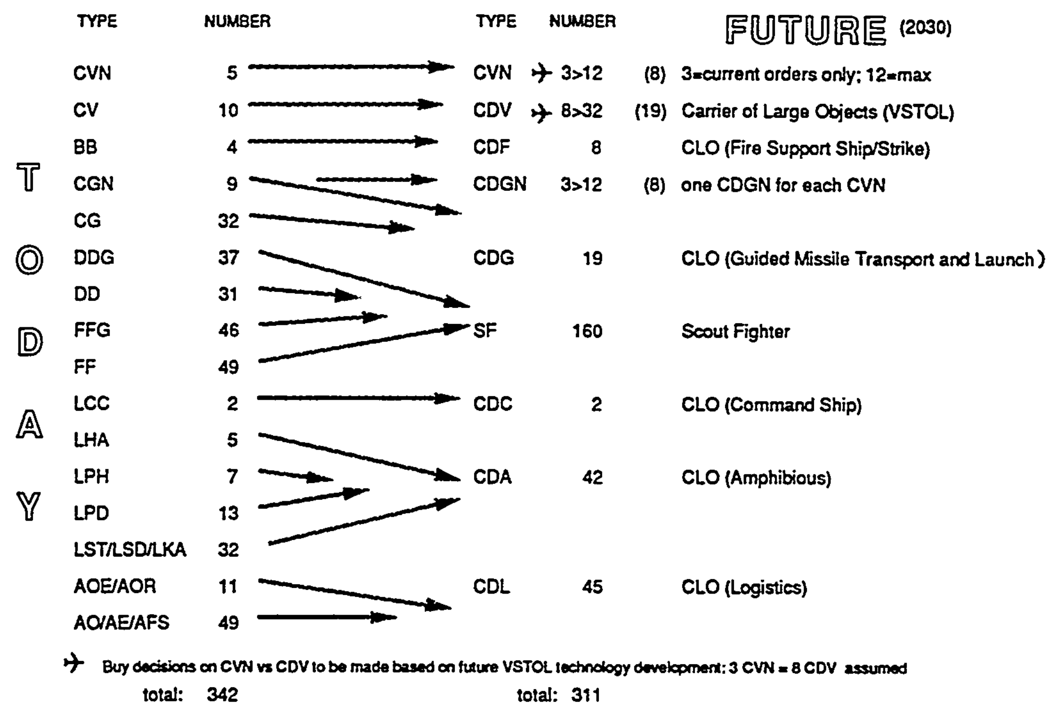


Fig. 13 – Surface fleet transition and future composition

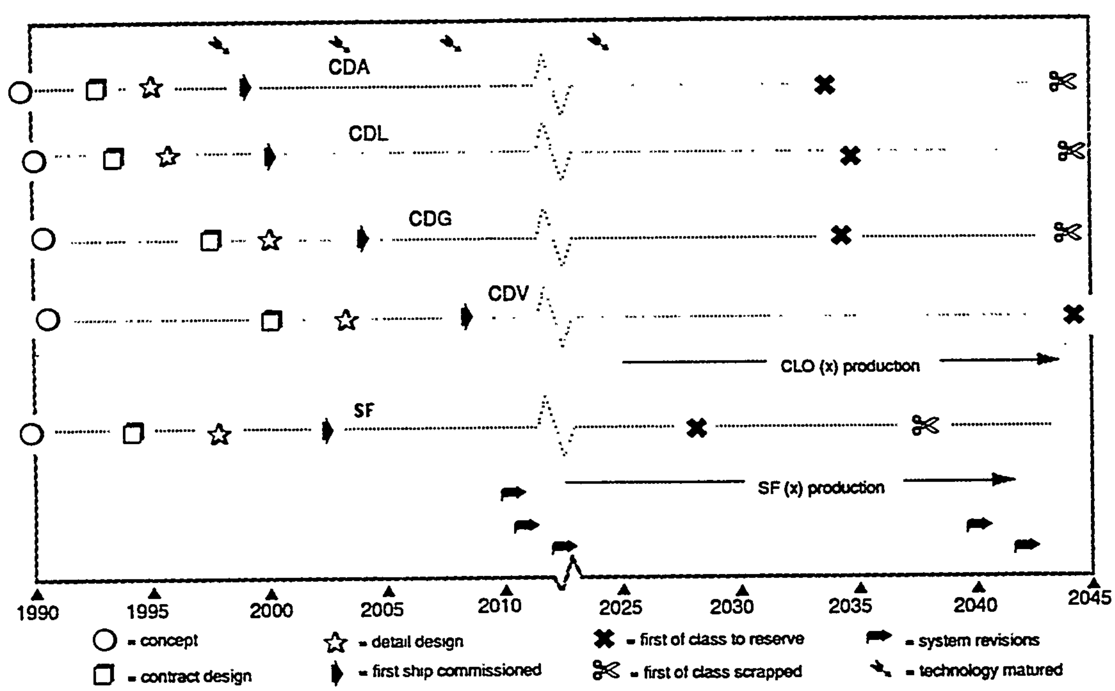


Fig. 14 – Proposed timeline for CDM and SF technology and procurement

Stabilized Number (+ reserves)		Class	Production Rate	Active Life (yrs)	Reserve Life (yrs)
8	(+2)	CVN	one every 5 or 6 years	45	10
8	(+2)	CGN	one every 3 or 4 years	30	10
19	(+5)	CDV	one every 1 or 2 years	35	10
42	(+12)	CDA	one or two every year	35	10
45	(+13)	CDL	one or two every year	35	10
19	(+6)	CDG	one every 1 or 2 years	30	10
2	(+1)	CDC	replacement	30	15
8	(+2)	CDF	one every 4 years	35	10
160	(+64)	SF	six or seven every year	25	10
311	(+107)				

- these numbers are CDM/SF replacements for current task force (CVBG, SAG, ATF, URG, CEG) only. Mine warfare, non-direct support logistics, repair/tender not included.

- ships with inherently hardmounted primary mission payload (CGN, CDG, CDC and SF) are assigned a shorter active life. Larger ships get a longer active life than smaller ships (notably the SF) as backfits and extensive modernizations are severely curtailed in favor of new construction. The CVN assumes SLEP at 30 yr point.
- the concept of flexible transition is used...first half of active life in highest threat environment, second half in lower threat, activated reserves to merchant escort and transport duties.

Fig. 15 – Postulated 2030 CDM/SF fleet makeup

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